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DETECTION AND MAPPING OF MINERALIZED AREAS IN THE CORTEZ-UINTA BELT, UTAH-NEVADA, USING COMPUTER-ENHANCED ERTS IMAGERY

TYPE II PROGRESS REPORT

(E76-10143) DETECTION AND MAPPING OF MINERALIZED AREAS IN THE CORTEZ-UINTA BELT, UTAH-NEVADA, USING COMPUTER-ENHANCED ERTS IMAGERY Progress Report (Geological Survey, Reston, Va.) 6 p HC $3.50 CSCL 08B G3/43

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A. Problems.

Ths most severe problem has been the delay in receiving high-altitude aircraft data. Although these data were acquired during spring 1975, the microfilm was not available until August. In addition, several more weeks elapsed before the data were delivered by the EROS Data Center. Consequently, the value of the seasonal coverage was greatly diminished.

Another problem has been mechanical failure of the Optronics, the prime film recording device in the Image Processing Laboratory at the Jet Propulsion Laboratory (JPL). This problem has delayed receipt of some of the enhanced images and has limited the usefulness of some images received. Although the problem has been alleviated somewhat by using the Variable Film Recorder (VFC), these images are not of optimum quality. Efforts are being made to develop another film-recording capability.

B. Accomplishments.

Enhanced images have been generated for all the test sites except Gold Hill, Utah. Included in the sets of enhanced images are contrast stretched images, linearly and logarithmically stretched ratio images, color-infrared composites and color-ratio composites. Computer compatible tapes (CCTs) have also been processed for three areas in addition to the approved formal test sites. These areas, the Virginia Range, Nevada; the Silver Bell mining district, Arizona; and the McDermitt caldera, Oregon-Nevada, provide a wider range of geologic conditions than is available from the approved sites. Analysis of all these images is underway to evaluate the effectiveness of the various enhancement techniques for showing the zones of alteration at each of the test sites.

During August, a highly successful field trip was conducted, mainly for making spectral-reflectance measurements of the altered rocks and of the most widely distributed unaltered rocks in south-central Nevada and in the Virginia Range southeast of Reno, Nevada. Approximately 350/0.45 to 2.5 μm spectra were collected under excellent sky conditions by using the JPL field portable spectrometer. Each sample site covered approximately 100 sq. cm. Representative rock and soil samples were collected at each site for mineralogical analyis and for laboratory measurements of spectral reflectance. These spectra, along with those collected previously, provide a total of approximately 600 spectra for determining the relationship between the mineralogy and visible and near-infrared spectral reflectance.

C. Significant Results.

Preliminary analysis indicates that mineralogical differences between altered rocks and most unaltered rocks in south-central Nevada cause visible and near-infrared (0.45 to 2.5 μm) spectral-reflectance differences, which can be used to discriminate these broad categories of rocks in multispectral images. The most important mineralogical differences are the increased abundance of goethite, hematite, and jarosite, and the presence of alunite, montmorillonite, and kaolinite in the altered rocks. Analysis of reflectance spectra recorded in the field shows that the altered rock spectra are characterized by broad absorption bands in the 0.45 to 0.50 μm and 0.85 to 0.95 μm regions, which are due to electronic processes in the iron ions,

and a band near 2.2 μm, which is due to vibrational processes in the OH ions. These features are absent or weak in most of the unaltered rock spectra. Therefore, the shapes of the 0.45 to 2.5 μm spectra for these altered and unaltered rocks are conspicuously different. However, because of the wavelength positions and widths of the Landsat Multispectral Scanner (MSS) bands, these spectral differences are not apparent in individual or color-infrared composite MSS images.

The technique developed to enhance these subtle spectral differences combines ratioing of the MSS bands and contrast stretching. The stretched ratio values are used to produce black-and-white images that depict materials according to spectral reflectance; ratioing minimizes the influence of topography and overall albedo on the grouping of spectrally similar materials. Color compositing of two or more stretched ratio images to form a color-ratio composite for discriminating between the altered and unaltered areas, as well as among many of the unaltered rocks in south-central Nevada, was accomplished by using the following diazo color and stretched ratio image combinations: blue for MSS 4/5, yellow for MSS 5/6, and magenta for MSS 6/7. Altered areas appear green and brown in this combination.

Field evaluation of this color-ratio composite shows that, excluding alluvial areas, approximately 80 percent of the green and brown color patterns are related to hydrothermal alteration. The remaining 20 percent consists mainly of pink hematitic crystallized tuff, a result of vapor-phase crystallization, and of tan and red ferruginous shale and siltstone. Discrimination of this unaltered tuff from the altered rocks may be possible

in the 2.2 μm region because this absorption band is absent in the tuff spectra. However, because the shale and siltstone are mineralogically and spectrally similar to the altered rocks, there appears to be little prospect of distinguishing these rocks from altered rocks in visible and near-infrared multispectral images.

D. Publications.

Rowan, Lawrence C., 1975, Application of satellite images to geologic exploration: American Scientist, v. 63, no. 4, pp. 393-403.

E. Recommendations.

In future experiments where seasonal aircraft coverage is important, NASA must find a mechanism for acquiring and dispersing the data more expeditiously than has been typical in this experiment.

Plans are being made to obtain visible and near-infrared images of several of the test sites by using the U. S. Geological Survey's Texas Instrument Multispectral Scanner mounted in its Queen Air aircraft. In its present configuration, this scanner has the Landsat MSS bands, a blue wavelength band, and two thermal-infrared detector positions. We hope to substitute 1.5 to 1.7 μm and 2.0 to 2.4 μm bands for the thermal detectors to evaluate the usefulness of the 2.2 μm band for discriminating altered and unaltered rocks. These data would be digitized and processed in the same manner that the MSS data are being processed.

F. Funds Expended.

Total expenditures - $17,809.40

Note: Of the approved $240,000, $140,000 was distributed directly to the Jet Propulsion Laboratory by NASA

G. Data Use.

	Value of data allowed	Value of data ordered	Value of data received
Images	$ 2,600.00	$1, 657.00	$1, 657.00
Photos	11,540.00	969.00	969.00
CCTs	12,000.00	540.00	540.00

H. Aircraft Data.

Color and color-infrared photographs have been used extensively in the field and laboratory for evaluating enhanced MSS images. These photographs are nearly indispensable for determining the areal distribution of vegetation and alluvial materials, and for logistical purposes. However, as previously mentioned, the value of these photographs was diminished, especially for vegetation studies, because of the long delay in receiving the data.